

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) An apparatus for the production of fatty acid alkyl ester comprising:

a first tank having a first outlet for providing naturally occurring fatty acids;

a second tank having a second outlet for providing an alkaline solution;

a third tank having a third outlet for providing an alcohol;

one inlet pipe coupled to said first, second and third outlets;

a reaction chamber having

an inlet in the bottom portion thereof coupled to said inlet pipe for receiving

an emulsion comprising a combination of said fatty acids, said alkaline solution and said alcohol, for transesterification of said emulsion in the presence of ultrasonic energy,

an outlet in the top portion of said chamber, and

an ultrasonic device with an ultrasonic transmission horn ~~inserted~~ extending into the interior of said chamber and at least partially immersed in said received emulsion such that said horn is in direct contact with said emulsion high intensity ultrasonic energy is coupled directly to said received emulsion creating a transesterified emulsion;

a natural gravity separatory coupled to said outlet for receiving said transesterified emulsion, said separatory having a discharge comprising fatty acid alkyl ester; and

a centrifuge for receiving said discharge and removing impurities therefrom.

2. (Original) The apparatus of Claim 1, wherein said naturally occurring fatty acids are animal fats.
3. (Original) The apparatus of Claim 1, wherein said naturally occurring fatty acids are vegetable oils.
4. (Previously Presented) The apparatus of Claim 1, wherein said alkaline solution is a concentrated form of one of the group comprising sodium hydroxide, potassium hydroxide, sodium methoxide, potassium methoxide, and other strong mineral alkaline solutions.
5. (Original) The apparatus of Claim 1, wherein said alcohol is one of the group comprising methanol, ethanol, propanol, and other monoalkyl alcohols.
6. (Cancelled)
7. (Cancelled)
8. (Previously Presented) The apparatus of Claim 1, wherein said reaction chamber comprises:
a cooling jacket containing a pump fed flow of a cooling liquid for maintaining said reactor chamber at a defined temperature.

9. (Cancelled)

10. (Previously Presented) The apparatus of Claim 8, wherein said ultrasound device provides ultrasonic energy at frequencies of between generally about 20 kHz and generally about 50 KHz.

11. (Previously Presented) The apparatus of Claim 8, wherein said ultrasound device provides ultrasonic energy at power densities of between generally about 18 Ws/ml and generally about 65 Ws/ml.

12. (Previously Presented) The apparatus of Claim 8, wherein said reaction chamber is maintained at an operating temperature of between generally about 70°C and generally about 80°C and an operating pressure of between generally about 1.0 and generally about 5.0 atmospheres.

13. (Previously Presented) The apparatus of Claim 8, wherein said natural gravity separation operates to separate said transesterified emulsion into a glycerol solution and fatty acid alkyl ester.

14. (Original) The apparatus of Claim 13, wherein said fatty acid alkyl ester is introduced into said centrifuge for washing and drying, wherein said washing and drying involves the

removal of traces of the catalyst, residual alcohol, and any remaining glycerol, soaps, and excess water.

15. (Cancelled)

16. (Withdrawn) A method for the production of fatty acid alkyl ester comprising the steps of:

a) providing an emulsion of naturally occurring fatty acids, an alkaline solution and an alcohol;

b) ultrasonically irradiating said emulsion to enhance the transesterification process;

c) separating said transesterified emulsion into a glycerol solution and fatty acid alkyl ester using a natural gravity separatory; and

d) washing and drying said fatty acid alkyl ester in a centrifuge to remove any remaining catalyst, alcohol, glycerol, soaps, and excess water.

17. (Withdrawn) The method of Claim 16, wherein said naturally occurring fatty acids are animal fats.

18. (Withdrawn) The method of Claim 16, wherein said naturally occurring fatty acids are vegetable oils.

19. (Withdrawn) The method of Claim 16, wherein said alkaline solution is a concentrated form of one of the group comprising sodium hydroxide, potassium hydroxide, sodium methoxide, potassium methoxide, or other strong mineral alkaline solutions.
20. (Withdrawn) The method of Claim 16, wherein said alcohol is one of the group comprising methanol, ethanol, propanol, and other monoalkyl alcohols.
21. (Withdrawn) The method of Claim 16, wherein said transesterification of said emulsion occurs in a reaction chamber, and wherein said reaction chamber comprises a horn.
22. (Withdrawn) The method of Claim 21, wherein said horn ultrasonically irradiates said emulsion at frequencies between generally about 20 kHz to generally about 50 kHz.
23. (Withdrawn) The method of Claim 21, wherein said horn operates at power densities of between generally about 18 Ws/ml and generally about 65 Ws/ml.
24. (Withdrawn) The method of Claim 21, wherein said reaction chamber is maintained at a specific temperature of between generally about 70°C and generally about 80°C and an operating pressure of between generally about 1.0 and generally about 5.0 atmospheres.

25. (Withdrawn) A method for the production of fatty acid alkyl ester comprising the steps of:

- a) providing a naturally occurring fatty acid;
- b) providing an alkaline solution;
- c) providing an alcohol;
- d) emulsifying said naturally occurring fatty acid, said alkaline solution and said alcohol;
- e) transesterifying said emulsion at controlled temperatures and pressures;
- f) gravitationally separating said transesterified emulsion into a glycerine solution and fatty acid alkyl ester; and
- g) washing and drying said fatty acid alkyl ester in a centrifuge to remove any remaining catalyst, residual alcohol, glycerol, soaps, and excess water.

26. (Withdrawn) The method of Claim 25, wherein said naturally occurring fatty acids are animal fats.

27. (Withdrawn) The method of Claim 25, wherein said naturally occurring fatty acids are vegetable oils.

28. (Withdrawn) The method of Claim 25, wherein said alkaline solution is a concentrated form of one of the group comprising sodium hydroxide, potassium hydroxide, sodium methoxide, potassium methoxide, or other strong mineral alkaline solutions.

29. (Withdrawn) The method of Claim 25, wherein said alcohol is one of the group comprising methanol, ethanol, propanol, and other monoalkyl alcohols.
30. (Withdrawn) The method of Claim 25, wherein said transesterification of said emulsion occurs in a reaction chamber.
31. (Withdrawn) The method of Claim 30, wherein said transesterification occurs at a specific temperature of between generally about 70°C and generally about 80°C and an operating pressure of between generally about 1.0 and generally about 5.0 atmospheres.
32. (Withdrawn) The method of Claim 25, wherein said gravitationally separated fatty acid alkyl ester is washed in said centrifuge using a solution of warm, deionized water.
33. (Withdrawn) The apparatus of Claim 5, wherein excess alcohol loading of between generally about 0% to generally about 2.4% stoichiometric requirements per weight of said naturally occurring fatty acid is used in said production.
34. (Withdrawn) The method of Claim 20, wherein excess alcohol loading of between generally about 0% to generally about 2.4% stoichiometric requirements per weight of said naturally occurring fatty acid is used in said production.

35. (Withdrawn) The method of Claim 29, wherein excess alcohol loading of between generally about 0% to generally about 2.4% stoichiometric requirements per weight of said naturally occurring fatty acid is used in said production.

36. (Previously Presented) The apparatus of Claim 1, wherein said third tank is configured to provide said alcohol at an excess loading level of generally about 0% to about 2.4% of stoichiometric requirements per weight of said naturally occurring fatty acid.

37. (Previously Presented) The apparatus of Claim 36, wherein naturally occurring fatty acids are at least one of animal fats and vegetable fats.

38. (Previously Presented) The apparatus of Claim 37, wherein said alkaline solution is a concentrated form of one of the group comprising sodium hydroxide, potassium hydroxide, sodium methoxide, potassium methoxide, and other strong mineral alkaline solutions.

39. (Previously Presented) The apparatus of Claim 38, wherein said alcohol is one of the group comprising methanol, ethanol, propanol, and other monoalkyl alcohols.

40. (Previously Presented) The apparatus of Claim 39, wherein said reaction chamber comprises:

 a cooling jacket containing a pump fed flow of a cooling liquid for maintaining said reactor chamber at an operating temperature of between generally about 70°C and

generally about 80°C; and

wherein said ultrasound device provides ultrasonic energy at frequencies of between generally about 20 kHz and generally about 50 KHz, power densities of between generally about 18 Ws/ml and generally about 65 Ws/ml, and said reaction chamber is maintained at an operating pressure of between generally about 1.0 and generally about 5.0 atmospheres.

41. (Currently Amended) A system for production of ASTM biodiesel fuel comprising:

supply tanks for supplying naturally occurring fatty acids, an alkaline solution and an alcohol directly to a common conduit;

an ultrasonic reaction chamber having an inlet in its bottom portion coupled to said common conduit and an ultrasonic horn extending into the interior thereof such that said horn is at least partially immersed in, and in direct contact with, an emulsion of said fatty acids, alkaline solution and alcohol received via said inlet, for transesterification of an emulsion in the presence of ultrasonic energy imparted directly into said emulsion under pressure of between about 1.0 atmosphere and about 5.0 atmospheres, said reaction chamber being encased in a cooling jacket for maintaining a temperature between about 70°C to about 80°C, said emulsion comprising a mixture of said naturally occurring fatty acids, said alkaline solution and said alcohol, and an outlet in the top portion of said chamber; and

a separatory coupled to said outlet for receiving said transesterified emulsion from said chamber and separating said transesterified emulsion into a fatty acid alkyl ester and a glycerine solution; and

wherein said ultrasonic energy is at a frequency between about 20 kHz and about 50 KHz, and at a power density between about 18 Ws/ml and about 65 Ws/ml.

42. (Previously Presented) The system of Claim 41, wherein said naturally occurring fatty acid is at least one of an animal fat and a vegetable fat.

43. (Presently Presented) The system of Claim 42, wherein said alkaline solution is one of sodium hydroxide, potassium hydroxide, sodium methoxide, potassium methoxide, and other strong mineral alkaline solutions.

44. (Previously Presented) The system of Claim 43, wherein said alcohol is one of methanol, ethanol, propanol, and other monoalkyl alcohols.